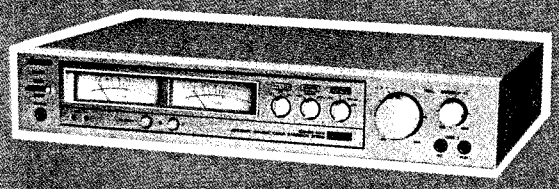
SERVICE DATA
FILE-NO. 100-140

TOSHIBA

ADRES UNIT

AD-4



SPECIFICATIONS

Number of channels:	4 (2 encoder channels and 2 decoder channels)
Input impedance:	50k ohm
Reference input level:	Encoder: 100 mV Decoder: 150 mV
Reference output level:	Encoder: 300 mV Decoder: 300 mV
Load impedance:	Not less than 10k ohm
CAL TONE:	300 mV (1 kHz at encoder output)
Reference adres level:	150 mV (1 kHz at encoder input)
Headphone output:	1mW (8 ohm)
Overall frequency response:	20 Hz ~ 20 kHz ± 1 dB (with respect to the 1 kHz reference I/O level)
adres effect: (with a Toshiba cassette deck)	Max. recording level: 7 dB improvement at 1 kHz Noise level: Reduced more than 30 dB at 10 kHz Reduced more than 20 dB at 1 kHz Reduced more than 17 dB at 100 Hz Dynamic range: 30 dB expansion at 1 kHz Overall SN ratio: More than 20 dB improvement Distortion: Reduced to ½ (0 dB at 400 Hz) Reduced to 1/6 for input overload (0 dB at 400 Hz)
Semiconductors:	ICs: 16 Transistors: 13 Diodes (including LEDs): 17
Power supply:	AC 220V ~ 50 Hz
Power consumption:	14 watts
Dimensions:	420(W) x 75(H) x 284(D)mm (including feet and knobs)
Weight:	4.3 kg
Accessories:	Connection leads 2

Specifications are subject to change without notice.

TE, U, TC

CONTENTS

1. FEATURES 2
2. OPERATING . . . . . 3 to 13
Types of Tape. 4
Glossary of Terms 4
Setting up your AD-4. 5
Principles of adres System. 6
Calibration. 7
Recording 9
Setting the Recording Level Playbcak 10
Tape Copying. 11
Operating Hints. 13
4. DISASSEMBLY INSTRUCTIONS 14
5. ELECTRICAL ADJUSTMENTS. 15
6. ELECTRICAL PARTS LOCATIONS 16
7. SCHEMATIC DIAGRAM 17
8. CABINET PARTS LOCATIONS 18
9. PARTS LIST . . . . . 19 to 22

1. FEATURES

adres (Automatic Dynamic Range Expansion System) is Toshiba's completely new noise reduction and dynamic-range expansion system specially designed for cassette tape systems.

- Dynamic-range on playback is greatly expanded right across the frequency range reaching an incredible 100 dB at 1 kHz. adres thus assures sound reproduction with the full dynamic range of the original source for practically any type of programme.
- Signal-to-noise ratio is improved dramatically: By 30 dB at 10 kHz eliminating all tape hiss, and 17 dB at 100 Hz.
- Complete matching with any type of tape and tape deck, through rms-level detectors in the level sensor circuits. Tonal quality is unaffected by a mismatch of up to ± 2 dB between record and playback signal levels.
- "Breathings" effects are virtually eliminated, making adres ideal for cassette recording and playback.

2. OPERATING

TAPE COPY Switch
If two tape decks are connected, tapes can be easily copied.

Peak Level Meters
Show left and right channel levels during recording and playback.

MONITOR Switch
Selects which signal is monitored.

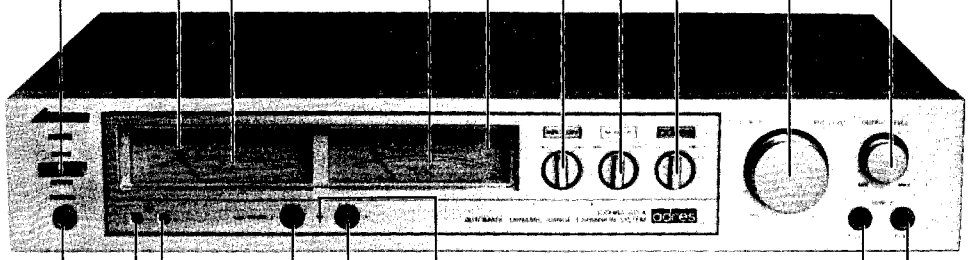
adres Switch
adres processing can be selected or defeated (bypassed).

OUTPUT Level Control
Adjusts the monitored playback level to both amplifier and headphones.

adres reference level marks AD

POWER Switch

RECORD Level Control



CALIBRATION Indicator
Lights when the adres Switch is set for calibration.

CALIBRATION Level Controls
(See page 7)

OSCILLATOR Signal Level Controls (Recessed)

Headphones Socket
The signal output to the Headphones Socket is selected with the MONITOR switch, and the signal level is adjusted with the OUTPUT Level Control.

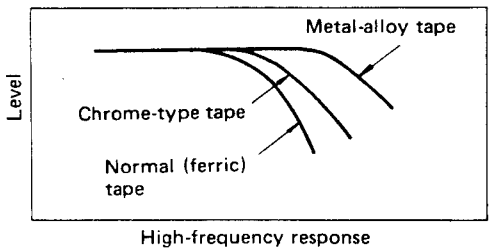
TAPE 2 Jacks
Easy access record and playback connections for a tape deck (see page6.)

Figure 1

Types of Tape

There are four basic tape types now widely available; Normal or Ferric tape, Chrome type tape, Metal-alloy tape, and Ferri-chrome tape. Selection of a tape type depends on what you wish to record, your tape deck characteristics, and the audio quality you wish to achieve. The adres system is effective with all tape types, but adres performance is greatly enhanced with high-quality tapes. If in doubt about the most suitable tape for your tape deck, consult your dealer and your tape deck instruction manual. adres system calibration will be greatly simplified if you consistently use one tape type and brand.

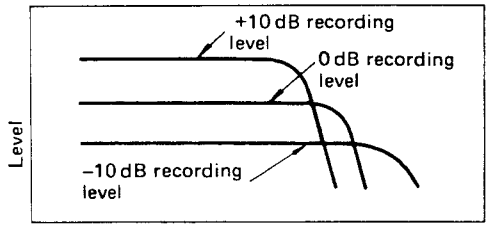
When setting the recording level, the characteristics of the tape should be taken into consideration. These characteristics include the recording and playback frequency response, the tape noise level, and the tape saturation level. These three vary considerably with tape type, and the frequency response also varies considerably with the recording level for any particular tape type. At a particular recording level, a metal-alloy tape, for instance, provides much better high-frequency response than a normal (ferric) tape, as shown in the Figure below.



High-frequency response vs. tape type

Tapes with better high-frequency response are clearly used to advantage for recording music with considerable high-frequency sound.

For any tape type, a lower recording level provides better high-frequency response, as shown below.



High-frequency response vs. recording level

Ideally, a lower recording level should be used for recording music with considerable high-frequency sound. But there is usually a disadvantage in lowering the recording level, which is that a signal recorded at a lower level is less easily separated from the inherent tape noise (tape hiss) on playback. This is particularly a problem on cassette tape where the signal to noise ratio is relatively low. On cassette tape, therefore, the recording level is conventionally set as high as possible up to just below the tape saturation level to minimize the tape noise on playback. This clearly reduces high-frequency response. With conventional tape decks and noise reduction systems, cassette tape offers inadequate dynamic range, either high noise levels or limited high-frequency response, and possible peak distortion through tape saturation. The adres system overcomes these limitations.

Glossary of Terms

Breathing

Signal processors, such as noise reduction systems or automatic recording level control systems, may cause an audible variation in background noise level. We call this variation "breathing." Breathing takes place when the response of a signal expander or compressor cannot catch up with input signal variations. The adres system is completely free from this annoying effect. The AD-4 uses an optimized-level sensor response and recovery time constant to achieve this. The human ear is particularly sensitive to breathing in the high-frequency range. But in the adres system, the background hiss itself is suppressed below the threshold of hearing.

dB (decibel)

Decibel is a logarithmic expression of loudness level (sound pressure).

An increase (decrease) of 20 dB with respect to a reference level represents an increase (decrease) ratio in loudness level of 10 times (one-tenth).

Therefore, 40 and 60 dB mean 100 and 1000 times as large as the reference loudness level.

Dynamic range

The dynamic range of group of sounds is the ratio (expressed in decibels) of the highest to lowest loudness levels in the sound. The dynamic range of live orchestra performances often exceeds 100 dB, but the dynamic range of everyday sound is usually about 60 dB.

nWb/m

The nWb, or nano Weber, is a unit of magnetic flux, here measured per metre. A signal at the 0 dB point on the meter scale of a tape deck represents a magnetic flux is of about 160 nWb/m with TOSHIBA and many other decks.

Oscillator (OSC)

The adres unit has a built-in 1 kHz oscillator. This electrical circuit generates an audio tone at the reference adres level. The AD-4 has two recessed oscillator signal level controls (on page 3). These preset the OSC tone −3dB.

Signal-to-Noise Ratio (S N ratio)

The S N ratio (expressed in decibels) is the ratio of the audio signal level to the noise level. A higher S N value indicates that there is less noise for the same audio signal.

Setting up your AD-4

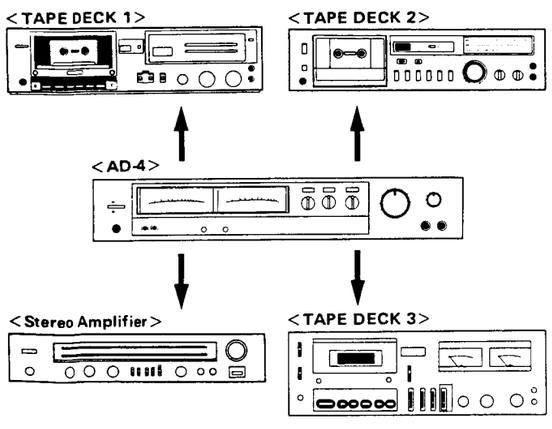
Before connecting your AD-4 to your Hi-Fi system, please read this manual carefully and note the position of the controls and connection sockets **(see page 3 and below).**

- There are many possible configuration of Hi-Fi systems to which the AD-4 can be connected. After connection to your system, the AD-4 unit controls must be calibrated with the tape deck, or decks, to ensure correct matching of signal levels. The simple step by step procedures for this are **described on pages 7 and 8.**
- Up to three tape decks—either cassette or open-reel—and a Hi-Fi amplifier/pre-amplifier can be connected to the AD-4. Both 2-head and 3-head decks can be used. Advanced switching allows easy monitoring, recording, playback and tape-to-tape copying with any of these decks, either with or without adres system processing.
- To connect the AD-4 to a system with one tape deck (or to the first tape deck if more than one is to be connected) proceed as follows:

①Note the length of the connecting leads, and decide on a position for the AD-4 unit.

WARNING:

- Sufficient ventilation must be provided at all times; therefore, do not position this unit, or other Hi-Fi equipment.
  - in places where there is oily smoke or where humidity is high,
  - near a stove or heater where the temperature is above 35°C,
  - on an unstable support such as corrugated cardboard,
  - on a soft fabirc, such as a rug,
  - in a place exposed to direct sunlight.
- Avoid a position close to other electrical equipment, such as a TV, this may generate hum.



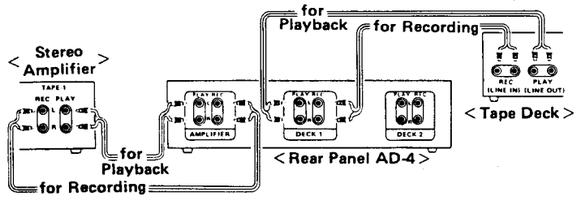
②Disconnect all power from your Hi-Fi system by removing the plugs from the AC outlets. (Be sure to pull the plug itself, never the cable.)

③Connecting to a stereo amplifier and tape deck:
Four audio leads are supplied with the AD-4.

- Plug any of the audio leads into the AD-4, AMPLIFIER sockets marked RECord, and plug the other end of this lead into the TAPE-REC sockets on your amplifier (or radio receiver)—use red plugs for the right (R) channel.
- Plug another of the audio leads into the AD-4, AMPLIFIER sockets marked PLAY, and plug the other end of this lead into the TAPE-PLAY sockets on your amplifier (or radio receiver).
- Plug another of the audio leads into the AD-4, DECK1-REC sockets, and plug the other end of this lead into the RECord (or LINE-IN) sockets of your tape deck.
- Plug the remaining audio lead into the AD-4, DECK1-PLAY sockets, and plug the other end of this lead into the PLAY (or LINE-OUT) sockets of your tape deck.
- Check that red plugs are used for all right channel connections.
- Insert all plugs fully to prevent noise.
- If your amplifier or tape deck has different type sockets, consult your amplifier or deck instruction manual and your dealer.

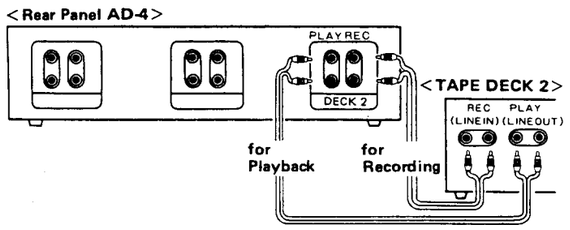
④Insert the AC mains plugs.

⑤Press the POWER switch on the AD-4 front panel. The meters will light.



■ Connecting to a second tape deck

- A second tape deck can be connected to either the DECK2 Phono sockets on the rear panel or the DECK2 jack sockets on the front panel.
- Audio leads, either with phono plugs for rear panel connections or with 6.3 mm jack plugs for front panel connections, can be obtained from your dealer.
- TAPE DECK2 connections to AD-4 rear panel.



- TAPE DECK2 connections to AD-4 front panel.

- Before making connections, unplug all AC leads to your Hi-Fi system.
- Connect the leads from a second tape deck to either the front panel or rear panel sockets, as shown above—red plugs for right channel, white for left.
- Insert plugs fully to prevent noise.
- Reconnect AC power leads.

■ Connecting to a third tape deck

With a second tape deck already connected, as described above, a third tape deck can be connected to the unused AD-4, DECK2 sockets either on the front panel or rear panel.

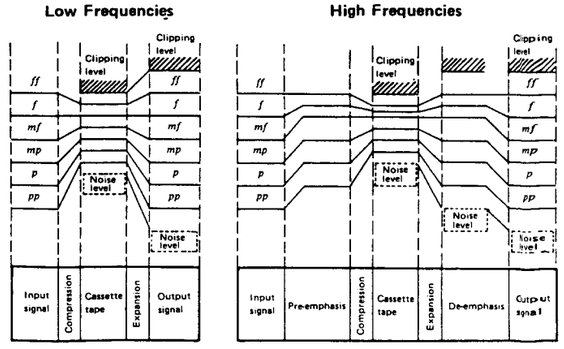
Note: Recordings can be made simultaneously on all three tape decks. But, playback from the deck connected to the rear panel DECK2 sockets is automatically switched off when jacks are inserted into the DECK2 sockets on the front panel **(see Playback on page 10).**

■ Connection of microphones

Microphones cannot be plugged directly into the AD-4 because the microphone signal level is too low.
A microphone mixer or microphone pre-amplifier can be connected to the AD-4, AMPLIFIER-REC sockets, then microphone(s) can be plugged into the mixer or pre-amplifier. Alternatively, with a normal Hi-Fi amplifier connected to the AD-4, as described above, microphones can be plugged directly into the amplifier MICrophone sockets or into the amplifier LINE-IN or AUX input sockets via a microphone mixer or microphone pre-amplifier.
Consult your dealer for information on a suitable microphone mixer.

Principles of adres System

Capturing on cassette tape the wide dynamic range of a live performance or a disc recording has conventionally been very difficult. The narrow tape width and low tape speed give a restricted dynamic range which is sandwiched between the relatively low tape saturation levels and high tape-hiss.
adres stands for Automatic Dynamic Range Expansion System. The AD-4 increases the dynamic range of cassette systems by up to 100 dB (at 1 kHz). It does this by compressing the amplitude range of the audio signals in its encoder circuits by a logarithmic factor of 1.5 before they are recorded on tape. After playback, decoder circuits expand the dynamic range again. During compression and expansion, variable emphasis circuits raise or lower the levels of the various audio signals by different amounts. For instance low-level, high-frequency signals are raised by about 18 dB before recording. At high-levels, emphasis is about 0 dB. A signal at 1 kHz, for example, if input at −30 dB is "encoded" to −20 dB for recording, and "decoded" back to −30 dB after tape playback. The changes of signal level by the encoder and decoder circuits are illustrated below.



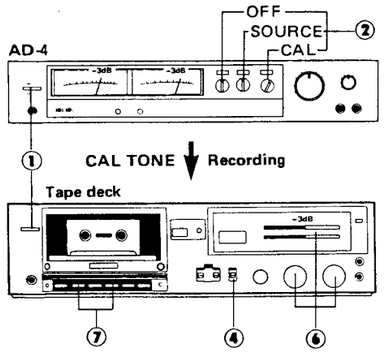
The noise level is reduced by 30 dB in high frequency range, for example, from −60 dB to −90 dB. Thus a vast improvement in signal to noise ratio is achieved.
Since high-amplitude signals have their levels reduced before recording, loud passages of music which otherwise cause tape saturation can be recorded with a large "head-margin." The harmonic distortion of high-amplitude signals, particularly at mid-range frequencies, is correspondingly greatly reduced. With this greater dynamic range, recording levels can be considerably reduced to give greatly extended high-frequency response and lower harmonic distortion particularly at mid-range frequencies at which the ear is most sensitive to distorted sound.

Calibration

Before using your AD-4 for recording, the signal levels for recording and playback must be aligned. This is done simply by recording on tape a fixed tone generated in the AD-4 unit, then playing back this tone through the AD-4. The level of the tone is adjusted during recording with the recording level control of each tape deck, and adjusted during playback with the AD-4 CALIBRATION level controls and the tape deck playback level control. Follow the procedures described below for recording level calibration and playback level calibration for each tape deck. If more than one tape deck is connected, first calibrate the deck with the lowest output level or no output level control. If you are not sure which deck has the lowest output begin by calibrating the tape deck connected to the TAPE DECK 1 sockets.

- For calibration, use the tape type of highest quality which you usually use or plan to use.
- After performing calibration of the first tape deck, do not change the settings of:
  - the AD-4 CALIBRATION level controls
  - the first tape deck recording level control(s)
  - the first tape deck playback level control(s)

Ⓐ Recording Level Calibration



<Numbers refer to the steps below>

① Switch on the power to the AD-4 unit, the tape deck to be aligned, and the stereo amplifier.
② Set the AD-4 switches as follows:
- adres switch to the CAL position. This switches on the tone generator.
- TAPE COPY switch to the OFF position.
- MONITOR switch to the SOURCE position.

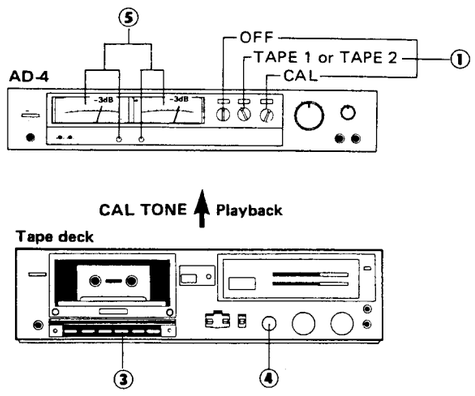
③ Load the tape deck (cassette or reel-to-reel) with tape for recording, and set the tape deck in the pause mode ready to record (so that the record level of the tone is indicated on the tape deck meters).
④ Set the tape deck Dolby* selector, if fitted, to OFF. AD-4 should not be used with Dolby system.
⑤ To audibly monitor the tone, set the stereo amplifier volume control to a moderate level and its function switch to monitor the tape input to which the AD-4 unit has been connected.
⑥ Adjust the tape deck recording-level control(s) until the tape deck meters indicate −3dB on each channel.

Note: ○ Set to −3dB (on VU meters or peak meters) when the Dolby reference mark ▯▯ is at +3dB (its usual position). Otherwise, set to 6dB lower than the Dolby mark.
○ Reel-to-reel decks usually have a higher 0dB level. But, to ensure accurate adres alignment when copying from an open-reel deck to cassette tape, we recommend that the tone should still be recorded at −3dB on open-reel tape.

⑦ Record approximately 20 seconds of CAL TONE on the head of the tape.
⑧ Note the setting of the tape deck recording level control, which should not subsequently be moved.

* "Dolby" and the double-D symbol are trademarks of Dolby Laboratories.

Ⓑ Playback Level Calibration



<Numbers refer to the steps below>

① Set the AD-4 controls as follows:
- MONITOR switch to either TAPE 1 or TAPE 2 depending on the tape deck being calibrated.
- TAPE COPY switch to the OFF position.
- adres switch to the CAL position.

② Wind back the tape to the head of the recorded tone.
③ Play back the recorded tone.
④ Set the output level control, (if fitted), on the tape deck to maximum—its normal position for adres playback.
⑤ Adjust the CALIBRATION level control (CAL) for each channel until the adres unit meters indicate −3dB.
- When playing back the tone, the tape deck meters may not indicate exactly −3dB. This reflects variations in tape sensitivity and record/playback characteristics, and is acceptable if the AD-4 meters indicate −3dB.
- If the tone playback level is unusually high and can not be reduced to −3dB with the CALIBRATION level controls, reduce the tape deck output level by adjusting the the tape deck output control(s) then readjust the CALIBRATION level controls.
- If the tone playback level is unusually low and can not be set to −3dB with the CALIBRATION level controls, perform the Recording Level Calibration again, but record the tone (step ⑥) at 0dB. Play back this tone, and set the playback level to −3dB on the AD-4 meters. This will cause a slight mismatch only when adres-encoded tapes are played back on an adres built-in deck.

■ Normally, alignment (calibration) of the adres system is necessary only when setting up for the first time. However, if the preset controls are accidentally moved or if a tape type is used which has different characteristics realignment will be necessary.
This can be done quickly by following procedures Ⓐ and Ⓑ above for a new tape type or to check alignment for an old tape. It is recommended, therefore, that 20 seconds of tone should be recorded on the head of each tape before recording and should not be erased. If a variety of tape types are used, alignment may be necessary for each type and playback level control positions should be memorized.

Calibration of a Second or Third Tape Deck

When the first tape deck is calibrated, the CALIBRATION level controls on the AD-4 are set and should not subsequently be moved. To adjust the calibration tone playback levels of second or third tape decks, the second or third deck output level controls alone must be used.

Tape deck with the lowest output level or no output level control (first deck)
Adjust the CAL controls on the adres unit for calibration.
Output level control set to maximum.
Other tape deck
Adjust the deck output level control for calibration.
Other tape deck
Adjust the deck output level control for calibration.
AD-4
-3dB
-3dB
CAL TONE Playback
Set the MONITOR switch to select the deck to be calibrated. Insert jacks to play back on front-panel connected deck, withdraw front panel jacks to play back on a deck connected to the DECK 2 sockets on rear panel.

Tape Deck Connected to TAPE DECK 2—Rear Panel Sockets

To align a tape deck connected to the TAPE DECK 2 sockets on the Rear Panel of the AD-4:

① Record a calibration tone by following procedure Ⓐ
② If jacks are plugged into the TAPE DECK 2 sockets on the AD-4 Front Panel, pull them out to allow playback from the TAPE DECK 2 Rear Panel sockets.
③ Set the AD-4 controls as follows:
- MONITOR switch to TAPE 2.
- TAPE COPY switch to OFF.
- adres switch to CAL.

④ Play back the recorded tone.
⑤ Adjust the output level control(s) of the tape deck until the AD-4 meters indicate −3dB.
- When the playback level from tape deck 2 is lower than that from tape deck 1, follow procedure Ⓑ completely for tape deck 2 adjusting the CALIBRATION level controls on the AD-4 as necessary, then set the MONITOR switch to TAPE 1 and adjust the output level control of tape deck 1 for the tone recorded on tape deck 1 until the AD-4 meters indicate −3dB.

Tape Deck Connected to TAPE DECK 2—Front Panel Sockets

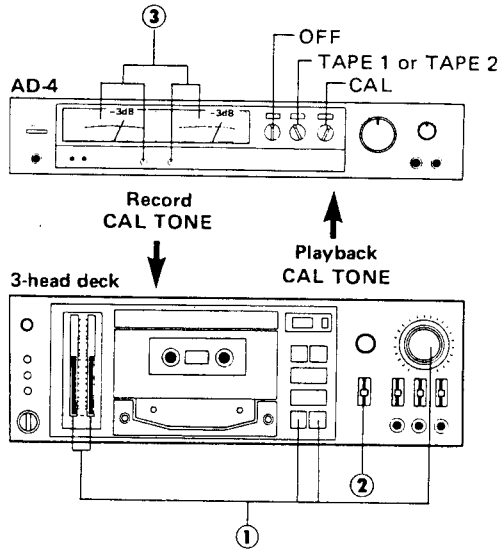
To align a tape deck connected to the TAPE DECK 2 sockets on the Front Panel of the AD-4:

① Record a calibration tone by following procedure Ⓐ.
② Set the AD-4 controls as follows:
- MONITOR switch to TAPE 2.
- TAPE COPY switch to OFF.
- adres switch to CAL.

③ Play back the recorded tone.
④ Adjust the output level control of the tape deck until the AD-4 meters indicate −3dB.
- If the tone playback level is too low to be adjusted to −3dB with the tape deck output level control alone, the output level from this deck is lower than that from the other decks already aligned. To align this deck follow procedure Ⓐ completely, then realign the other decks, as required, without moving the CALIBRATION level controls on the AD-4.

Calibration of 3-head Tape Decks

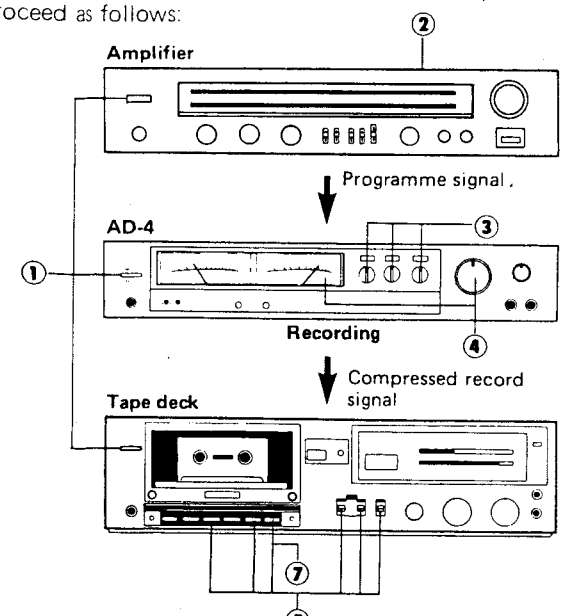
Tape decks with three heads (record, playback, and erase) can be calibrated in the same way as 2-head decks. Alternatively, they can also be calibrated in a single operation. To achieve this, start recording a tone and adjust the record level to −3dB as described above. Then while still recording, set the MONITOR switch to the appropriate TAPE position, and adjust the playback level indicated on the AD-4 meters to −3dB. As in the case of 2-head decks, to set the playback level during calibration, use the tape deck output control and the AD-4 CALIBRATION level controls if this is the first deck to be aligned; otherwise, use only the tape deck output level control.



① Adjust the CAL TONE record level to –3 dB.
② Set the monitor switch to TAPE.
③ Adjust the CAL TONE playback level to –3 dB.

Recording

When the AD-4 connected, recording operations are basically the same as when recording without the AD-4 except that the recording level is monitored on the AD-4 meters and adjusted with the RECORD level control on the AD-4. Recording from another tape deck (tape-copying) is described later on page 12. To record from disc, radio tuner, TV or microphone the desired source signal must pass through the pre-amplifier or amplifier, then through the adres unit to a tape deck. While the adres switch on the AD-4 is set to OFF, the signal passes through the AD-4 unchanged for recording and playback, but the AD-4 power must be on to permit this. When the adres switch is set to IN or MPX ON, adres signal processing takes place for recording and playback. To set up for recording proceed as follows:



① Switch on the power to the AD-4, the tape deck to be used, the amplifier and the programme source (turntable, radio tuner or TV).
② Set the switches on your amplifier to select the programme source to be recorded.
③ Set the AD-4 controls as follows:
- TAPE COPY switch to OFF.
- MONITOR switch to SOURCE.
- adres switch to MPX ON to make an adres-recording from an FM stereo broadcast or TV.
- adres switch to IN to make an adres-recording from other sources (disc, microphone).
- adres switch to OFF to make a non-adres recording. If for example the tape is to be played back on a system without an adres unit.

④ Play the source (disc, tuner), if possible at the loudest portion, and set the RECORD level control on the adres unit so that the adres peak-reading meters indicate the correct level (see Setting the Recording Level, on the next page).
- The tape deck recording level control, which was preset during alignment should not be touched.

⑤ Set up the tape deck for recording (set the tape deck's Dolby selector, if fitted, to OFF or OUT).
⑥ To record a CALIBRATION tone on the head of the tape:
- set the adres switch to the CAL position,
- record the tone for 20 seconds,
- press the pause button on the tape deck,
- return the adres switch to its previous position.

⑦ The source programme can now be recorded by pressing the pause button again.
- Up to three tape decks can record simultaneously.
- During recording, the monitored output may not have the full adres effect. High-frequency response may be reduced as a result of tape bias voltage leakage; however, this does not affect the recording, and the full adres effect will appear on playback.
- With a 3-head tape deck, off-tape monitoring is possible by setting the amplifier tape monitor switch to TAPE and selecting between SOURCE and TAPE with the AD-4 MONITOR switch. Alternatively, the AD-4 MONITOR switch can be set to TAPE and the amplifier switches used to select source or off-tape monitoring; this is not recommended, however, because the difference in output levels between the source and tape may not be covered by the AD-4 OUTPUT level control.

Setting the Recording Level

Whether recording with adres processing switched in or out, the recording level should be set carefully. We recommend that in either case the level should be set with the AD-4 RECORD level control and monitored on the AD-4 peak meters. For a particular piece or programme of music, the RECORD level control should normally be left at one setting throughout recording. This setting is established by monitoring the highest peaks of the loudest section of the programme in advance of actual recording. Where this is not possible, an estimated setting based on experience is required. The table below indicates the range into which these peaks may pass for cassette tape types. If they pass above these ranges, they will be distorted during recording.

Table 1 Recording Levels

Tape Type	Peak Level Meter Readings	Remarks
Metal	0 dB ~ +6 dB	Higher than the reference adres level
Chrome type	−5 dB ~ 0 dB	Almost at the reference adres level
Ferric (normal, low-noise)	−10 dB ~ −5 dB	Lower than the reference adres level

Note: During adres recording and playback, the level meters on the tape deck indicate the compressed signal.

On the other hand, if the signal peaks are set too far below the maximum distortion-free recording levels, the recorded signals will be too weak and inherent tape noise will be excessive on playback. Conventionally, the range on cassette tape between distortion of peaks and tape noise has been too narrow to record the full dynamic range of most music.

The adres system overcomes these limitations and makes possible a wide dynamic range. In setting the recording level for adres recording, there is a certain latitude of choice. Set the recording level according to the above table. A much lower recording level may have to be compensated on playback by turning up the amplifier volume control.

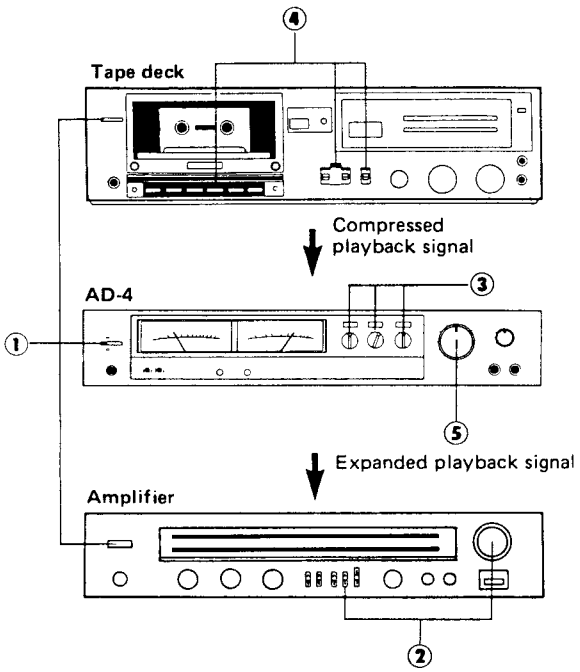
The recording level setting you choose, therefore, will partly depend on the tape type, your taste in listening, and the programme material. If the programme contains considerable high-frequency sound (high-pitched instruments or voices), a lower level setting than indicated in the table is recommended. This is discussed in more detail on page 4 and 6, under "Types of Tape" and "Principles of the adres System."

Open-reel Recording Levels

If exclusively open-reel tape equipment is to be used, the recording level should be set considerably higher than the reference adres level (−3 dB) ranges for cassette tape given in the table above since open-reel tape decks have a much wider dynamic range than cassette decks. But, if copies of open-reel tapes are to be made on cassette tape, the recording levels for open-reel tape should be set as indicated in the table to ensure correct matching with the narrower dynamic range of cassette tape.

Playback

To play back a tape with the AD-4 connected, proceed as follows:



<Numbers refer to the steps below>

① Switch on the power to the AD-4, the tape deck to be used, and the amplifier.

② Set the amplifier monitor switch to the TAPE position, and set the amplifier volume control at its normal position.

③ Set the AD-4 controls as follows:
- TAPE COPY switch to OFF.
- adres switch to IN for an adres recorded tape, or to OFF for a non-adres tape.
  [The MPX ON position has the same affect as IN,on playback.]
- MONITOR switch to TAPE 1 or TAPE 2 depending on the tape deck being used. To play back on a tape deck connected to the rear panel DECK 2 sockets, remove any jacks plugged into the front panel DECK 2 sockets.

④ Play the tape on the tape deck
[Check that the Dolby selector, if fitted, is set to OFF or OUT for an adres recorded tape.]

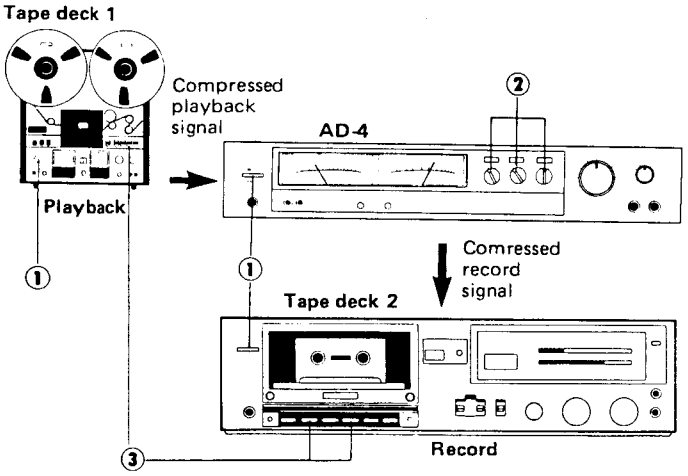
⑤ Adjust the adres unit OUTPUT volume control to a suitable listening level. If the level is too low with the adres OUTPUT control set to maximum, adjust the amplifier volume control; **do not move the tape deck output level control from the position set during playback calibration.**
- If a CALIBRATION tone was recorded on the head of the tape: Observe the level on the AD-4 meters. If the tone level deviates by more than 2 or 3 dB from the −3 dB adres reference level, adjust the CALIBRATION controls on the adres unit or tape deck output level control for perfect alignment.
- Power to the AD-4 must be switched on to play a non-adres tape with the adres switch set to OFF.

Tape Copying

Tape copying, or dubbing, is easily achieved with the AD-4 by playing back on one deck while recording on another. Separate compressor and expander circuits permit full adres copying without changing connections. In tape copying, the benefits of the adres system—extended frequency response and the elimination of tape noise—become invaluable. Copies can be made from cassette to cassette or open-reel to cassette virtually without deterioration of quality. The basic calibration, recording and playback procedures are used, as described on pages 7 – 10.

1. Full adres Copying

To make an adres copy of an adres recorded tape proceed as follows:



① Switch on the power to the AD-4, the tape decks to be used, and the amplifier if monitoring on speakers is required.

② Set the AD-4 controls as follows:
- adres switch to IN.
- MONITOR switch to TAPE 1 or TAPE 2 (the playback deck).
- TAPE COPY switch to [1 ▶ 2] or [2 ▶ 1] depending on which deck will play back and which record.

Note: The [1 ▶ 2] setting allows recording on either or both decks connected to the DECK 2 front or rear panel sockets.
The [2 ▶ 1] setting allows recording on the deck connected to the DECK 1 sockets; playback is from the front DECK 2 sockets if jacks are inserted or from the rear DECK 2 sockets if jacks are removed from the front panel DECK 2 sockets.

③ If the adres calibration is correct—the deck and adres CALIBRATION level controls have not been moved—begin copying by simply starting playback and recording simultaneously.

④ If an adres calibration tone was originally recorded on the head of the tape to be copied, the adres alignment can be simply checked, as follows:
- Play back the originally recorded adres tone.
- If the adres meters do not read exactly -3dB, adjust the CALIBRATION level controls on the AD-4 (or the deck output level control if necessary).
- Adjust the recording level control(s) on the recording deck until the calibration tone reads -3dB on the deck meters.

When recording a tape copy, copy the original calibration tone too.

Note: If an open-reel tape was adres recorded at a level substantially higher than the recommended level (see page 10, Open-reel Recording Levels), loss of high-frequency sound, or distortion, may occur in copying onto cassette tape.

■ Monitoring

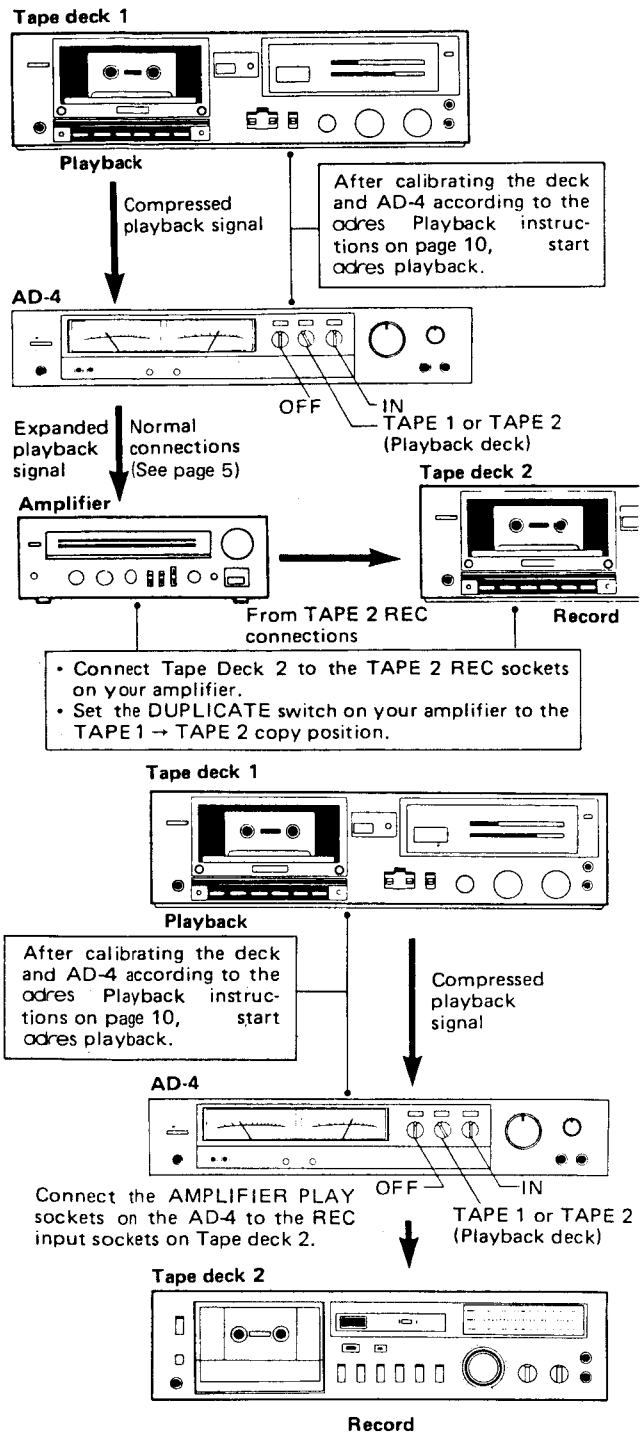
Any distortion of the sound of a source (such as a damaged disc or distortion caused in recording an original tape) may become accentuated or noticeable in a tape copy. Careful monitoring by listening on speakers, or preferably on high-quality headphones, will enable you to determine whether distortion is present in the original source or tape or is being caused during tape copying.
When copying, the expanded signal being played back can be monitored at your amplifier while the adres unit MONITOR switch is set to tape. Note that the signal at the headphone sockets of the tape decks is compressed during adres recording or playback of an adres tape.
If the recording deck is a 3-head deck, the signal being recorded can be monitored off-tape. To do this, set the 3-head deck's monitor switch to TAPE; the adres unit MONITOR switch can then select either off-tape monitoring (TAPE position) or original tape monitoring (SOURCE position).

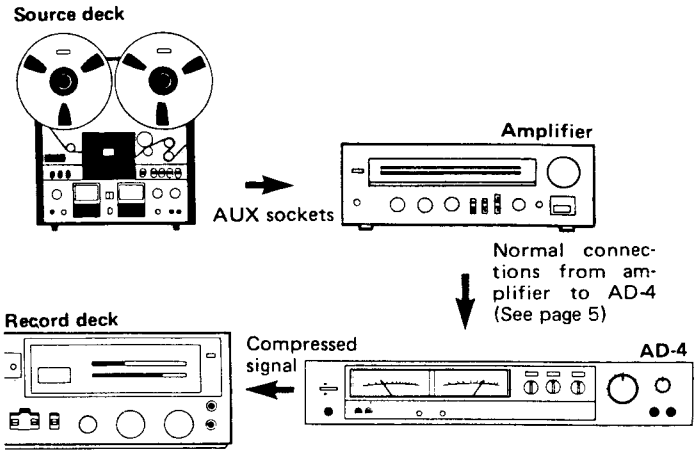
2. Non-adres Copying

A non-adres recorded tape can be copied directly through the AD-4 with the adres switch set to OUT, and TAPE COPY switch set to [1 ▶ 2] or [2 ▶ 1].

3. adres Tape to Non-adres Tape Copying

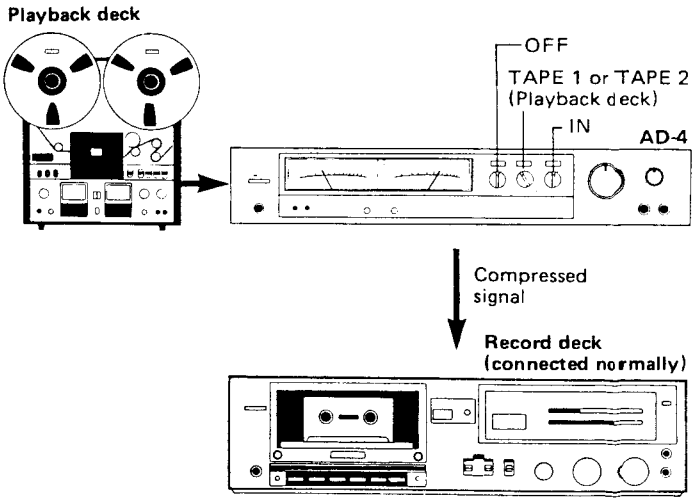
To make a non-adres recorded copy of an adres recorded tape, either of the two methods shown below may be used. If your amplifier does not have a TAPE DUPLICATE switch, use the second method. Reconnection of the record deck is required.


Tape deck 1
Playback
Compressed playback signal
After calibrating the deck and AD-4 according to the adres Playback instructions on page 10, start adres playback.
AD-4
OFF
IN
TAPE 1 or TAPE 2 (Playback deck)
Expanded playback signal
Normal connections (See page 5)
Amplifier
Tape deck 2
From TAPE 2 REC connections
Record
• Connect Tape Deck 2 to the TAPE 2 REC sockets on your amplifier.
• Set the DUPLICATE switch on your amplifier to the TAPE 1 → TAPE 2 copy position.
Tape deck 1
Playback
After calibrating the deck and AD-4 according to the adres Playback instructions on page 10, start adres playback.
Compressed playback signal
AD-4
Connect the AMPLIFIER PLAY sockets on the AD-4 to the REC input sockets on Tape deck 2.
OFF
IN
TAPE 1 or TAPE 2 (Playback deck)
Tape deck 2
Record



① Connect the source deck's PLAY output sockets to the amplifier's TAPE 2 playback or AUX sockets.
② Set the DUPLICATE or FUNCTION switch on your amplifier to pass the input signal from TAPE 2 to TAPE 1, or from AUX to TAPE 1.
③ After calibrating the AD-4 and record deck according to the instructions on page 8, start adres recording.

There are many other useful ways in which the AD-4 can be connected. The block diagram **on page 13 shows** the switching system of the AD-4 to enable you to devise your own connections. If you have any difficulty, consult your dealer.



4. Non-adres Tape to adres Tape Copying

To make an adres recorded copy of a non-adres recorded tape, either of the two methods shown below may be used. The second method does not require an amplifier with a TAPE DUPLICATION switch. The example shows be making an adres copy on cassette tape of a programme recorded without adres on a 2-track 15" open-reel recorder. Reconnection of the playback deck is required.

① Connect the playback deck's PLAY sockets to the AMPLIFIER REC input sockets on the AD-4.
② After calibrating the unit and record deck according to the **instructions on page 7,** start adres recording.

Operating Hints

- To ensure maximum adres effectiveness, frequently clean and demagnetize the entire tape path including the heads of your tape deck. Demagnetizing (degaussing) should be done very carefully in accordance with the demagnetizer instructions.
- If noise is present in the source, it will be reproduced in playback. The adres system is designed to eliminate the tape noise generated during recording and playback. Careful monitoring on headphones will enable you to detect any noise in a source.
- If external interference, such as high-frequency radio interference is present in the source, try to eliminate it by setting the adres switch to the MPX ON position. This switches in a low-pass filter to eliminate interference above 19 kHz, which would other wise cause incorrect operation of the encoder and decoder circuits.

3. BLOCK DIAGRAM

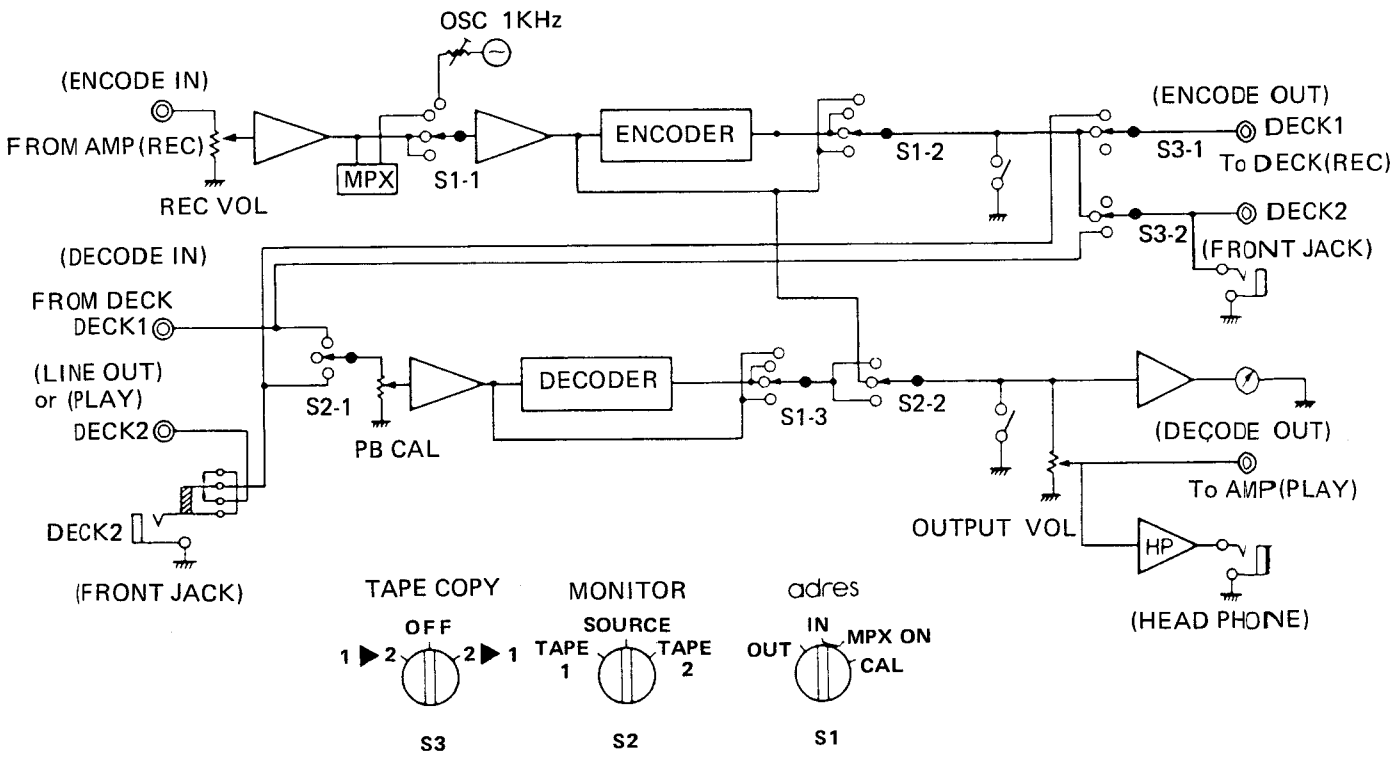


Figure 2

4. DISASSEMBLY INSTRUCTIONS

Removal of Top Cover

1. Remove three screws (A) from rear panel.
2. Remove four screws (B) holding both sides of top cover.
3. Pull off top cover upward after lifting rear side of top cover, then top cover can be removed.

Removal of Front Panel

1. Remove top cover.
2. Remove three knobs (C) from front panel.
3. Loose three screws (D) holding bottom plate.
4. Remove two screws (E) holding front panel from bottom side.
5. Remove three screws (F) holding front panel from top side.
6. Front panel can be removed to the direction of arrow.

   CAUTION: When removing front panel, front panel must be removed carefully . Because meter lead wires can be damaged.

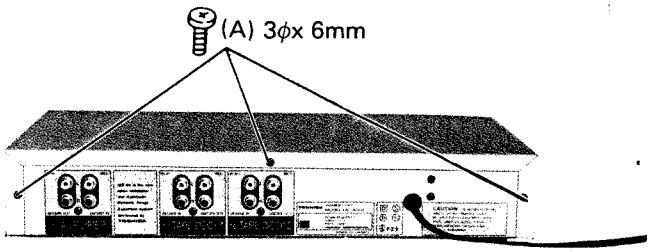


Figure 3

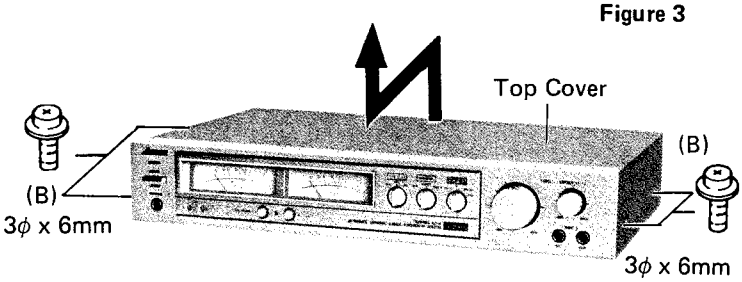


Figure 4

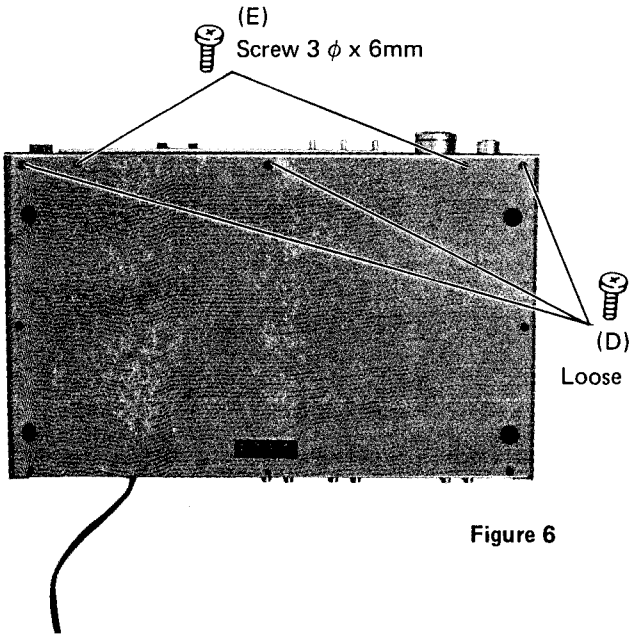


Figure 6

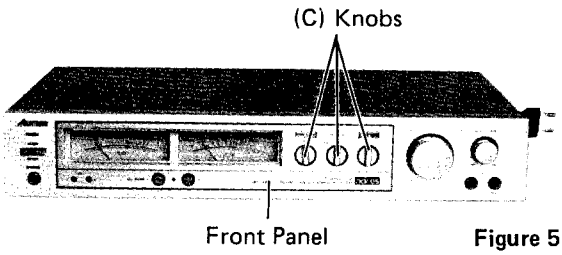


Figure 5

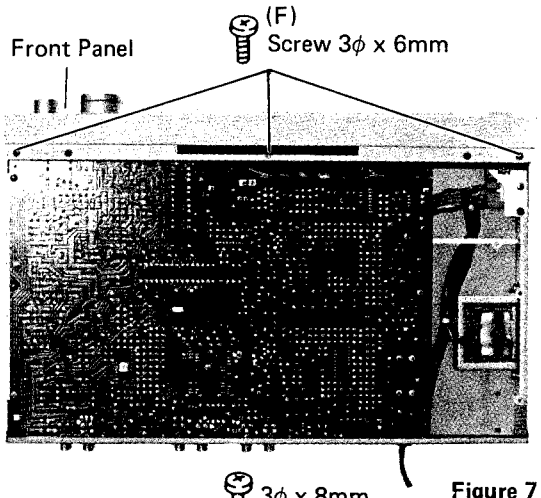


Figure 7

Removal of Bottom Plate

1. Remove five screws (G) and three screws (H) holding bottom plate, then bottom plate can be removed.

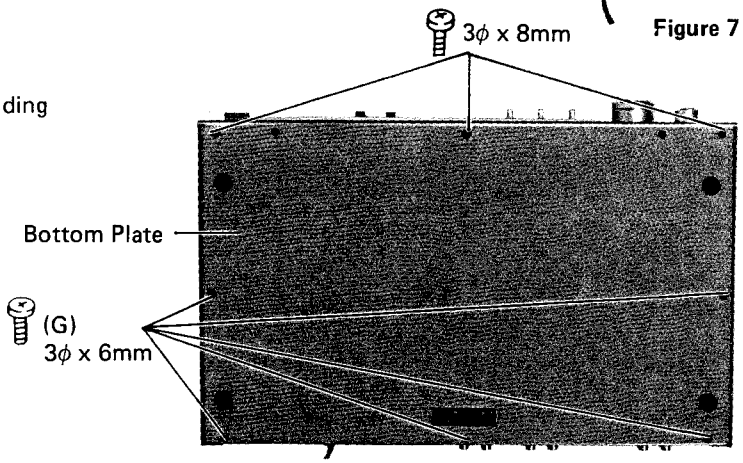


Figure 8

5. ELECTRICAL ADJUSTMENTS

NOTE: Proceed adjustment in aging five minutes longer.

No.	Adjustment Item	Nominal Spec.	Volume		Switch		Input Signal	Input	Adjustment Parts	Test Point	Remarks (0 dB = 1V)
			REC	OUT	Adres	MONITOR					
1	ENCODE DISTORTION	Less than 0.13%	MAX	MAX	IN	SOURCE	1 kHz –20 dB (100mV)	REC (AMP)	R417 (L) R418 (R)	TP2 (L) TP2 (R)	Adjust for minimum.
2	ENCODE Level Adjustment (1)	(300mV) ± 0.3 dB	MAX	MAX	IN	SOURCE	1 kHz –20 dB (100mV)	REC (AMP)	R662 MAX	TP1 (L) TP1 (R)	Adjust input for 300 mV (Attenator)
3	ENCODE Level Adjustment (2)	(300mV) ±0.3 dB	MAX	MAX	IN	SOURCE	Same as above 2	REC (AMP)	R481 (L) R482 (R)	TP2 (L) TP2 (R)	
4	Confirming "Item 1"	(300mV) ± 0.3 dB	MAX	MAX	IN	SOURCE					
5	LIMITER Adjustment	–2±0.3 dB	MAX	MAX	IN	SOURCE	1 kHz → 10 kHz –20 dB (100mV)	REC (AMP)	R475 (L) R476 (R)	TP2(L) TP2 (R)	Adjust for –2 dB at 10 kHz per 1 kHz (L/R)
6	DECORD Distortion	Less than 0.09%	MAX	MAX	IN	TAPE 1	1KHz –16.5 dB (150mV)	PLAY (DECK)	R519 (L) R520 (R)	TP5 (L) TP5 (R)	Adjust for Minimum
7	DECODE Level Adjustment (1)	(300mV) ± 0.3 dB	MAX	MAX	IN	TAPE 1	1 kHz –16.5 dB (150mV)	PLAY (DECK)	R487 (L) R488 (R)	TP4 (L) TP4 (R)	Adjust Input for 300 mV (Attenator)
8	DECODE Level Adjustment (2)	(300mV) ± 0.3 dB	MAX	MAX	IN	TAPE 1	Same as above 7	PLAY (DECK)	R551 (L) R552 (R)	TP5 (L) TP5 (R)	
9	Cofirming "Item 6"		MAX	MAX	IN	SOURCE					
10	LIMITER Adjustment	+ 2 ± 0.3 dB	MAX	MAX	IN	SOURCE	1 kHz → 10 kHz –16.5 dB (150mV)	PLAY (DECK)	R505 (L) R506 (R)	TP5 (L) TP5 (R)	Adjust for +2 dB at 10 kHz per 1 kHz (L/R)
11	CAL Frequency	1 kHz ± 5 Hz	MAX	MAX	CAL	TAPE 1	———	—	R655	TP1 (L) TP1 (R)	
12	CAL LEVEL Adjustment	300mV ± 0.3 dB	MAX	MAX	CAL	TAPE 1	———	—	R607 (L) R608 (R)	TP1 (L) TP1 (R)	
13	CAL DISTORTION	0.2 to 1% (1 kHz ± 50 Hz)	MAX	MAX	CAL	TAPE 1	———	—	R655	TP1 (L) TP1 (R)	Comfirm distortion is 0.2 to 1% .
14	METER Adjustment	–3 dB	MAX	MAX	CAL	TAPE 1	———	—	R605 (L) R606 (R)	Meter	Measure by setting the meter up properly (Adjust variable resistor from the hole of P.C.Board's bottom side.)

CONDITIONS

- Frequency . . . . . 1 kHz ±5% (950 Hz to 1050 Hz)
- Standard Input Level
  1. Encode Input Level . . . 100 mV ±0.2 dB (98 mV to 102 mV)
  2. Decode Input Level . . . 150 mV ±0.2 dB (147mV to 153 mV)

NOTE: These values are indicated when equipment are set up.

- Equipment. . . . . Output readings at Test Point are taken across over a 47 Kohm termination.

NOTE: In normal operating conditions, the voltage at each Test Point is shown as follows:

(Input Level at Encode. . . . 1 kHz, 100mV
Input Level at Decode . . . . 1 kHz, 150mV)

	ENCODE	DECODE	TOLERANCE
TP 1 / TP 2	300 mV		±0.5 dB
TP 4 / TP 5		300 mV	±0.5 dB
TP 3 / TP 6	DC 0 to –2.5 mV	DC 0 to +2.5 mV	DC 0 to ±3.5 mV

ADRES Switch Position (Connection)

1. RECORD Position (L ch ADJ.). . . WHT (R ch ADJ.) . . . RED

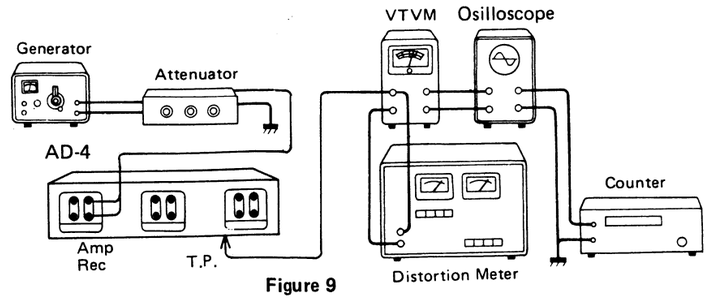


Figure 9

2. PLAY Position (L ch ADJ.). . . WHT (R ch ADJ.) . . . RED

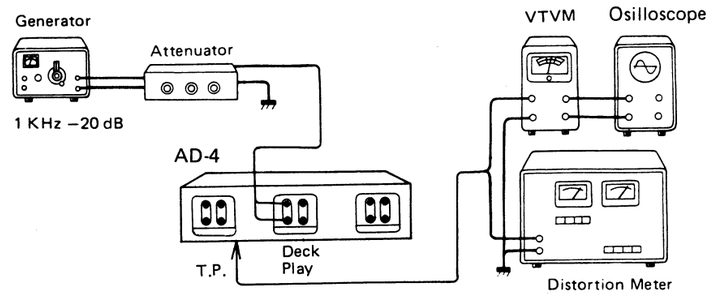


Figure 10

ADJUSTMENT LOCATIONS

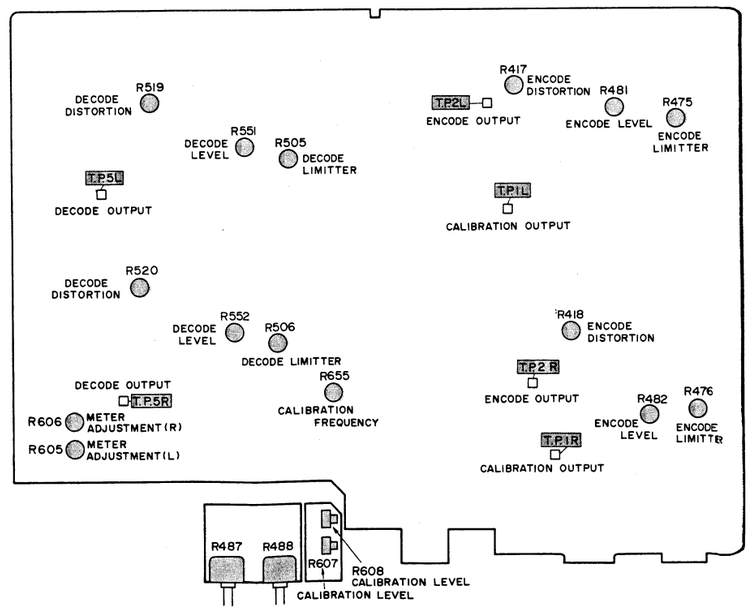


Figure 11

6. ELECTRICAL PARTS LOCATIONS

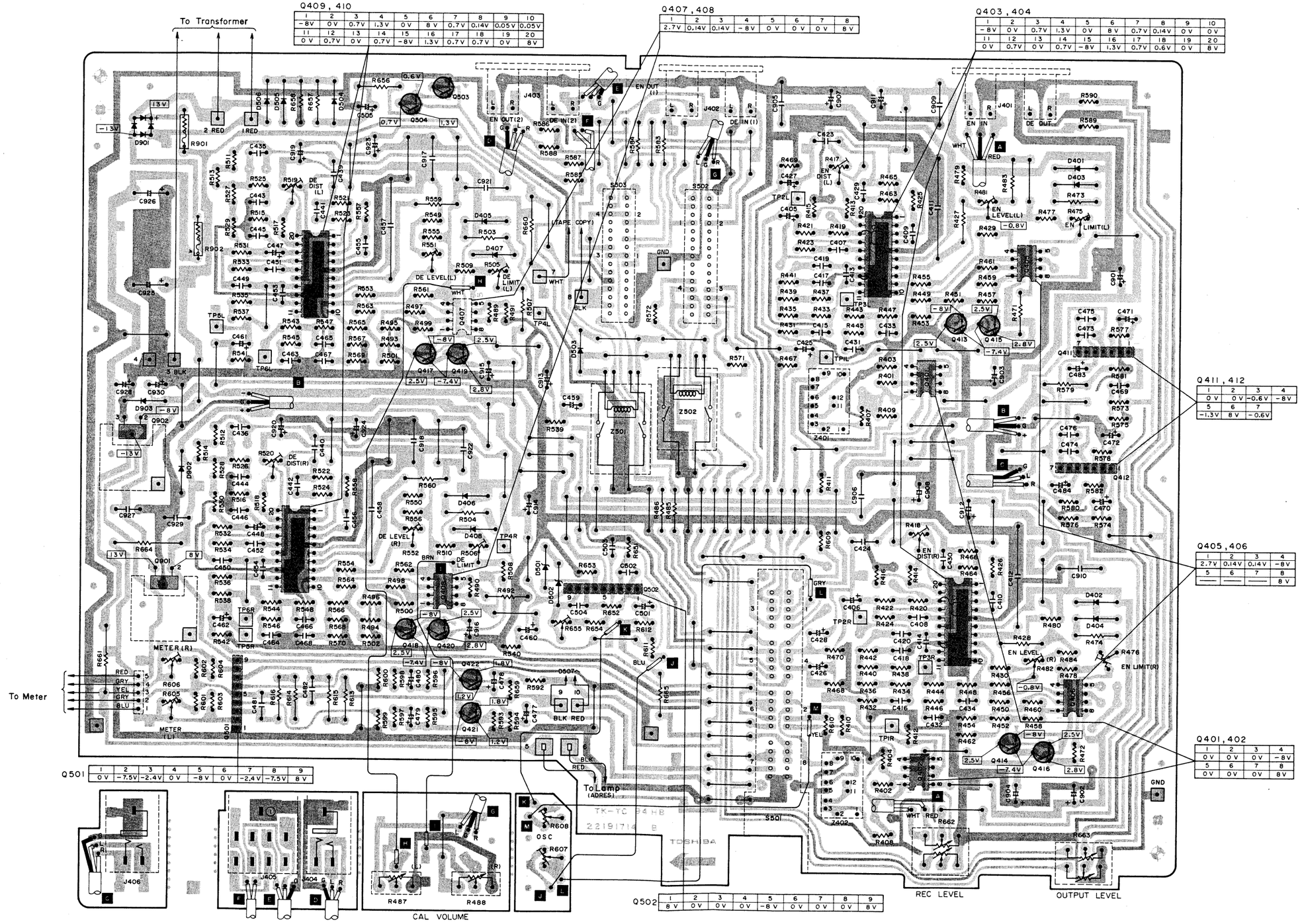


Figure 12

7. SCHEMATIC DIAGRAM

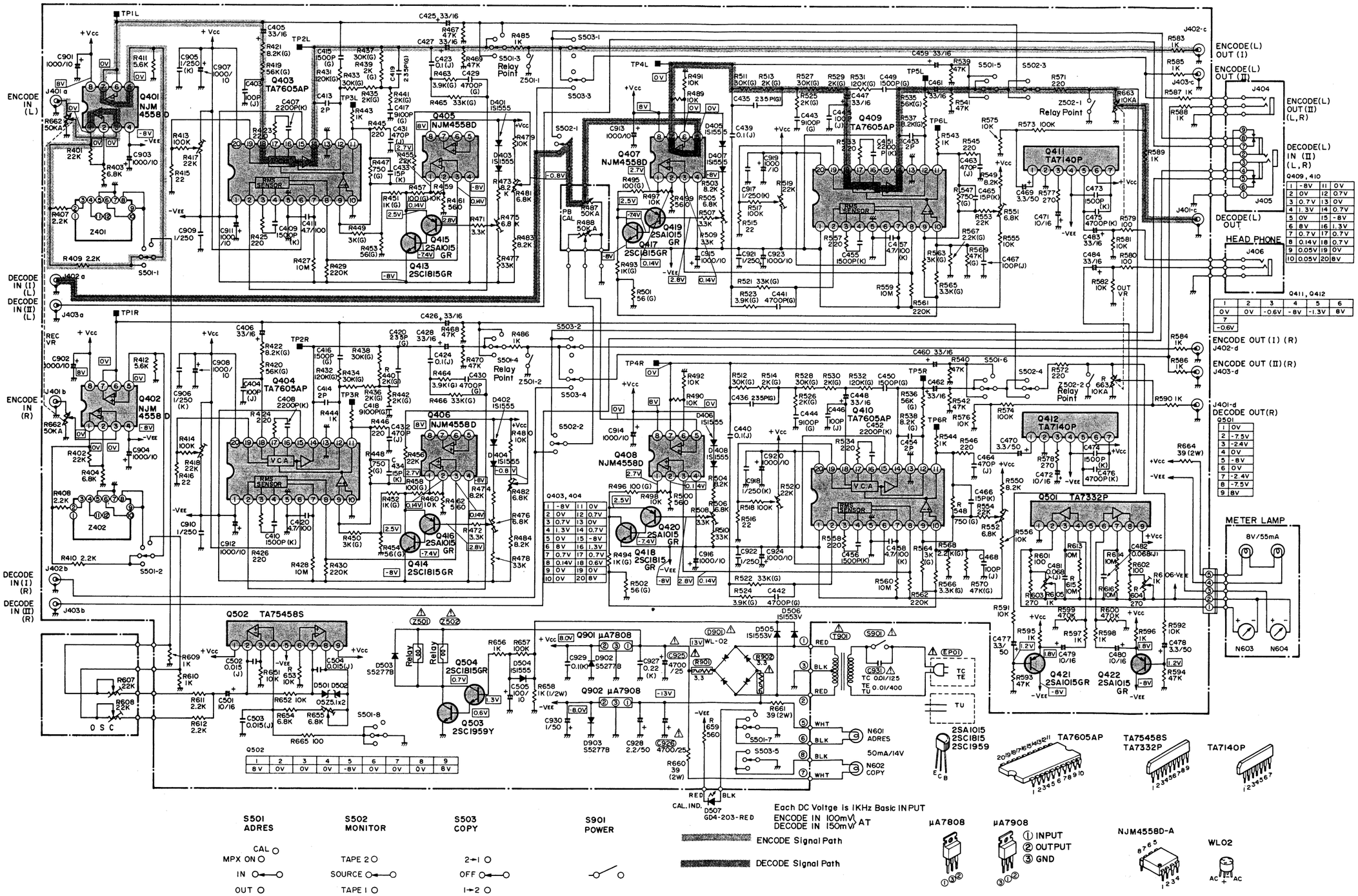
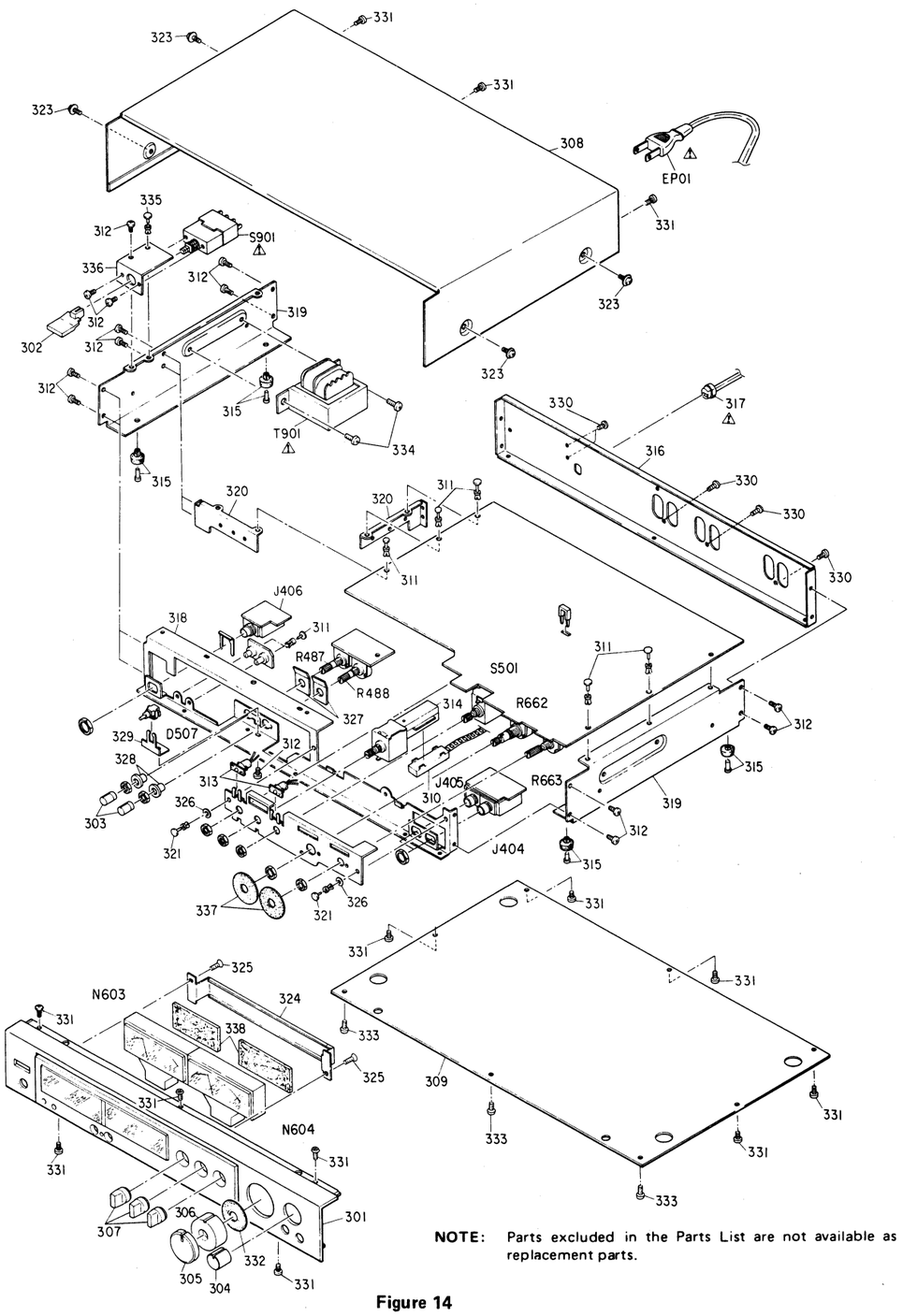


Figure 13

CAUTION:
The ⚠ mark, the symbol No. circled with rectangle in the schematic diagram and the shaded area in the parts list designate components which have special characteristics important for safety and should be replaced only with types identical to those in the original circuit or specified in the parts list.

8. CABINET PARTS LOCATIONS



NOTE: Parts excluded in the Parts List are not available as replacement parts.

Figure 14

9. PARTS LIST

CAUTION
The ⚠ mark , the symbol No. circled with rectangle in the schematic diagram and the shaded area in the parts list designate components which have special characteristics important for safety and should be replaced only with types identical to those in the original circuit or specified in the parts list.

Symbol No.	Part No.	Description
		CABINETS
301	25819447	Front Panel Ass'y, (TC)
301	25819454	Front panel Ass'y, (TE, TU)
302	25837437	Knob, Power
303	25837430	Knob, Calibration Volume
304	25837477	Knob, Output
305	25837511	Knob, Record, Left
306	25837512	Knob, Record, Right
307	25837393	Knob, Select
308	25838469	Cover, Top
310	22195549	Wire, Remote (S502, 503)
311	22705020	Rivet, Plastic, 3ϕ x 4.5mm
312	22707445	Screw, DT BID, 3ϕ x 6mm
313	25841230	Holder, Lamp
314	22195550	Control, Switch
315	22874027	Foot, Rubber
316	25838466	Plate Jack (TC)
316	25838467	Plate Jack (TE)
316	25838468	Plate Jack (TU)
⚠ 317	25845120	Bush, Nylon (TC)
⚠ 317	25845528	Bush, Nylon (TE, TU)
321	22705022	Rivet, Plastic, 3ϕ x 5.5mm
322	22707454	Screw, BID, 4ϕ x 8mm
323	22707522	Screw, FL DT, 3ϕ x 6mm
325	22707304	Screw, FLT, Tapping, 3ϕ x 8mm
326	22703253	Washer, 4ϕ
330	22701326	Screw, BID, Tapping, 3ϕ x 8mm
331	22707446	Screw, DT BID, 3ϕ x 6mm
332	22758058	Sheet, Mask
333	22707456	Screw, FL DT, 3ϕ x 8mm
334	22703131	Washer, 4ϕ
335	22705021	Rivet, Plastic, 3ϕ x 3.5mm
337	22703269	Washer, 3ϕ
338	25858534	Sheet, Meter
340	22705023	Rivet, Plastic, 3.5ϕ x 5.5mm
341	22950885	Label, Cushion (TE)
		TRANSISTORS, DIODES AND ICS
Q401, 402	22114470	IC, NJM4558D-A
Q403, 404		IC, TA7605P
Q405, 406	22114470	IC, NJM4558D-A
Q407, 408	22114470	IC, NJM4558D-A
Q409, 410		IC, TA7605AP
Q411, 412		IC, TA7140P
Q413, 414		Transistor, 2SC1815-GR
Q415, 416		Transistor, 2SA1015-GR
Q417, 418		Transistor, 2SC1815-GR
Q419, 420		Transistor, 2SA1015-GR
Q421, 422		Transistor, 2SA1015-GR
Q501		IC, TA7332P
Q502		IC, TA75458S
Q503		Transistor, 2SC1959-Y
Q504		Transistor, 2SC1815-GR
Q901	22114823	IC, μA7808
Q902	22114822	IC, μA7908
D401, 402		Diode, 1S1555V
D403, 404		Diode, 1S1553V
D405, 406		Diode, 1S1555V
D407, 408		Diode, 1S1555V
D501, 502		Diode, 05Z5.1
D503		Diode, S5277B
D504		Diode, 1S1555V
D505, 506		Diode, 1S1555V
D507	22115515	Diode, GD4-203-RED
⚠ D901	22115485	Diode, WL02M
D902, 903		Diode, S5277B
		ELECTRICAL PARTS
⚠ T901	22223816	Transformer, Power (TC)
⚠ T901	22223817	Transformer, Power (TE)
⚠ T901	22223818	Transformer, Power (TU)
Z401, 402	22153075	Filter Block, Dolby
Z501, 502	22148661	Relay
S501	22195551	Switch, Rotary, ADRES
S502	22195548	Switch, Slide, MONITOR
S503	22195548	Switch, Slide, COPY
⚠ S901	22195226	Switch, Push, POWER (TC)
⚠ S901	22146295	Switch, Push, POWER (TE)
⚠ S901	22195552	Switch, Push, POWER (TU)
N601, 602	22113313	Lamp, Pilot, ADRES/COPY, 50mA/14V

Symbol No.	Part No.	Description
N603, 604	22104525	Meter, Peak
N605, 606	22113512	Lamp, Meter, 55mA/8V
J401, 402	22163798	Jack, US4P,
J403		ENCORD/DECORD
J404	22163777	Jack, ENCORD OUT
J405	22167791	Jack, DECORD IN
J406	22163777	Jack, Headphone
⚠ EP01	22176572	Cord, Power (TC)
⚠ EP01	22176286	Cord, Power (TE)
⚠ EP01	22176536	Cord, Power (TU)

CAPACITORS

G= ± 2%, J=±5%, K= ± 10%, M = ± 20%, P = –0 + 100%
ABBREVIATIONS: EL = Electrolytic, CD = Ceramic Disk
MY = Mylar, PS = Polystyrene
PP = Polypropylene,
MPF = Metalized Polyester Film

C403, 404	22321082	PP, 100pF, 50V, J
C405, 406	22485330	EL, 33mfd, 16V
C407, 408	22372222	MY, 2200pF, 50V, K
C409, 410	22372152	MY, 1500 pF, 50V, K
C411, 412	22370232	MPF, 4.7mfd, 100V, K
C413, 414	22380123	PS, 2pF, 125V, M
C415, 416	22321094	PP, 1500pF, 100V, G
C417, 418	22321181	PP, 9100pF, 100V, G
C419, 420	22380125	PS, 235pF, 250V, G
C423, 424	22371104	MY, 0.1mfd, 50V, J
C425, 426	22485330	EL, 33mfd, 16V
C427, 428	22485330	EL, 33mfd, 16V
C429, 430	22321157	PP, 4700pF, 100V, G
C431, 432	22321053	PP, 470pF, 50V, J
C433, 434	22380106	PS, 15pF, 500V, K
C435, 436	22380124	PS, 235pF, 250V, G
C439, 440	22371104	MY, 0.1mfd, 50V, J
C441, 442	22321157	PP, 4700pF, 100V, G
C443, 444	22321181	PP, 9100pF, 100V, G
C445, 446	22321082	PP, 100pF, 50V, J
C447, 448	22485330	EL, 33mfd, 16V
C449, 450	22321094	PP, 1500pF, 100V, G
C451, 452	22372222	MY, 2200pF, 50V, K
C453, 454	22380123	PS, 2pF, 125V, M
C455, 456	22372152	MY, 1500pF, 50V, K
C457, 458	22370232	MPF, 4.7mfd, 100V, K
C459, 460	22485330	EL, 33mfd, 16V
C461, 462	22485330	EL, 33mfd, 16V
C463, 464	22321053	PP, 470pF, 50V, J
C465, 466	22380106	PS, 15pF, 500V, K
C467, 468	22321082	PP, 100pF, 50V, J

Symbol No.	Part No.	Description
C469, 470	22488339	EL, 3.3mfd, 50V
C471, 472	22485100	EL, 10mfd, 16V
C473, 474	22349152	CD, 1500pF, 50V, K
C475, 476	22349472	CD, 4700pF, 50V, K
C477, 478	22488339	EL, 3.3mfd, 50V
C479, 480	22485100	EL, 10mfd, 16V
C481, 482	22371683	MY, 0.068mfd, 50V, J
C483, 484	22485330	EL, 33mfd, 16V
C501	22485100	EL, 10mfd, 16V
C502	22371153	MY, 0.015mfd, 50V, J
C503	22371153	MY, 0.015mfd, 50V, J
C504	22371153	MY, 0.015mfd, 50V, J
C505	22483101	EL, 100mfd, 10V
C901, 902	22483102	EL, 1000mfd, 10V
C903, 904	22483102	EL, 1000mfd, 10V
C905, 906	22370208	MPF, 1mfd, 250V, K
C907, 908	22483102	EL, 1000mfd, 10V
C909, 910	22370208	MY, 1mfd, 250V, K
C911, 912	22483102	EL, 1000mfd, 10V
C913, 914	22483102	EL, 1000mfd, 10V
C915, 916	22483102	EL, 100mfd, 10V
C917, 918	22370208	MY, 1mfd, 250V, K
C919, 920	22483102	EL, 1000mfd, 10V
C921, 922	22370208	MY, 1mfd, 250V, K
C923, 924	22483102	EL, 1000mfd, 10V
⚠ C925, 926	22440373	EL, 4700mfd, 25V
C927	22372224	MY, 0.22mfd, 50V, K
C928	22488229	EL, 2.2mfd, 50V
C929	22372104	MY, 0.1mfd, 50V, K
C930	22488109	EL, 1mfd, 50V
⚠ C931	22340140	CD, 0.01mfd, AC125V, P (TC)
⚠ C931	22340147	CD, 0.01mfd, AC400V, P (TE, TU)

RESISTORS

All resistors are carbon film ¼W, ± 5% unless otherwise noted. G = ± 2%

R401, 402	22555223	22k ohm
R403, 404	22555682	6.8k ohm
R407, 408	22555222	2.2k ohm
R409, 410	22555222	2.2k ohm
R411, 412	22555562	5.6k ohm
R413, 414	22555104	100k ohm
R415, 416	22555220	22 ohm

Symbol No.	Part No.	Description
R417, 418	22658281	22K ohm, Semi-fixed
R419, 420	22550146	56k ohm, G
R421, 422	22550324	8.2K ohm, G
R423, 424	22555221	220 ohm
R425, 426	22555221	220 ohm
R427, 428	22545106	10M ohm
R429, 430	22555224	220k ohm
R431, 432	22550323	120k ohm, G
R433, 434	22550143	30k ohm, G
R435, 436	22550235	2k ohm, G
R437, 438	22550143	30k ohm, G
R439, 440	22550235	2k ohm, G
R441, 442	22550235	2k ohm, G
R443, 444	22555102	1k ohm
R445, 446	22555221	220 ohm
R447, 448	22550151	750 ohm, G
R449, 450	22550152	3k ohm, G
R451, 452	22550147	1k ohm, G
R453, 454	22550134	56 ohm, G
R455, 456	22555223	22k ohm
R457, 458	22550135	100 ohm, G
R459, 460	22555103	10k ohm
R461, 462	22555561	560 ohm
R463, 464	22550229	3.9k ohm, G
R465, 466	22550144	33k ohm, G
R467, 468	22555473	47k ohm
R469, 470	22555473	47k ohm
R471, 472	22555332	3.3k ohm
R473, 474	22545822	8.2k ohm
R475, 476	22658425	6.8k ohm, Semi-fixed
R477, 478	22555333	33k ohm
R479, 480	22555103	10k ohm
R481, 482	22658425	6.8k ohm, Semi-fixed
R483, 484	22545822	8.2k ohm
R485, 486	22555102	1k ohm
R487, 488	22624416	50k ohm, A, Variable (Calibration)
R489, 490	22555103	10k ohm
R491, 492	22555103	10k ohm
R493, 494	22550147	1k ohm, G
R495, 496	22550135	100 ohm, G
R497, 498	22555103	10k ohm
R499, 500	22555561	560 ohm
R501, 502	22550134	56 ohm, G
R503, 504	22545822	8.2k ohm
R505, 506	22658425	6.8k ohm, Semi-fixed
R507, 508	22545332	3.3k ohm
R509, 510	22555333	33k ohm
R511, 512	22550143	30k ohm, G
R513, 514	22550235	2k ohm, G
R515, 516	22555220	22 ohm
R517, 518	22555104	100k ohm
R519, 520	22658281	22k ohm, Semi-fixed
R521, 522	22550144	33k ohm, G

Symbol No.	Part No.	Description
R523, 524	22550229	3.9k ohm, G
R525, 526	22550235	2k ohm, G
R527, 528	22550143	30k ohm, G
R529, 530	22550235	2k ohm, G
R531, 532	22550323	120k ohm, G
R533, 534	22555221	220 ohm
R535, 536	22550146	56k ohm, G
R537, 538	22550324	8.2k ohm, G
R539, 540	22555473	47k ohm
R541, 542	22555473	47k ohm
R543, 544	22555102	1k ohm
R545, 546	22555221	220 ohm
R547, 548	22550151	750 ohm, G
R549, 550	22555822	8.2k ohm
R551, 552	22658425	6.8k ohm, Semi-fixed
R553, 554	22555223	22k ohm
R555, 556	22555103	10k ohm
R557, 558	22555221	220 ohm
R559, 560	22545106	10M ohm
R561, 562	22555224	220k ohm
R563, 564	22550152	3k ohm, G
R565, 566	22550138	3.3k ohm, G
R567, 568	22550137	2.2k ohm, G
R569, 570	22550231	47k ohm, G
R571, 572	22555221	220 ohm
R573, 574	22555104	100k ohm
R575, 576	22555103	10k ohm
R577, 578	22555271	270 ohm
R579, 580	22555101	100 ohm
R581, 582	22555103	10k ohm
R583, 584	22555102	1k ohm
R585, 586	22555102	1k ohm
R587, 588	22555102	1k ohm
R589, 590	22555102	1k ohm
R591, 592	22555103	10k ohm
R593, 594	22555473	47k ohm
R595, 596	22555102	1k ohm
R597, 598	22555102	1k ohm
R599, 600	22555474	470k ohm
R601, 602	22555101	100 ohm
R603, 604	22555271	270 ohm
R605, 606	22658291	1k ohm, Semi-fixed
R607, 608	22658280	22k ohm, Semi-fixed
R609, 610	22555102	1k ohm
R611, 612	22555222	2.2k ohm
R613, 614	22545106	10M ohm
R615, 616	22545106	10M ohm
R651, 652	22555103	10k ohm
R653	22555103	10k ohm
R654	22555682	6.8k ohm
R655	22658425	6.8k ohm, Semi-fixed
R656	22555102	1k ohm

Symbol No.	Part No.	Description
R657	22545104	100k ohm
R658	22547102	1k ohm
R659	22555561	560 ohm
R660, 661	22570302	39 ohm, 2W, Metal Oxided Film
R662	22655415	50k ohm, A, Variable (Record)
R663	22651492	10k ohm, A, Variable (Out put)
R664	22570302	39 ohm, 2W, Metal Oxided Film
R665	22545101	100 ohm
⚠ R901, 902	22500168	3.3 ohm, Fusible

TOSHIBA CORPORATION
2-1, GINZA 5-CHOME, CHUO-KU, TOKYO 104, JAPAN

PRINTED IN JAPAN 22955948 Sep. 1980 Ⓢ